Applications of the Analytic Hierarchy Process (AHP) in Management

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4th International Conference on Advanced Research in Business and Social Sciences

25-26 October, 2017; Bangkok

Presentation Outline

- Introduction to AHP
- Applications of AHP
  1. Human Resource Management
  2. Total Quality Management
  3. Strategic Management
  4. Operations Management
  5. Marketing Management
  6. Environmental Management
  7. Information Systems management
  8. Financial Management

Introduction:

Decision making is an important part of our life.

People have continuously devised **means and ways** to enlarge their abilities to cope with the growing complexity of their decision making problems.

Decision making problems:

-- Deterministic

-- Probabilistic

Decision making problems:

-- **Number of decision makers**

  -- Single decision maker

  -- A group of decision makers

-- **Number of criteria**

  -- Single criterion

  -- Multiple criteria

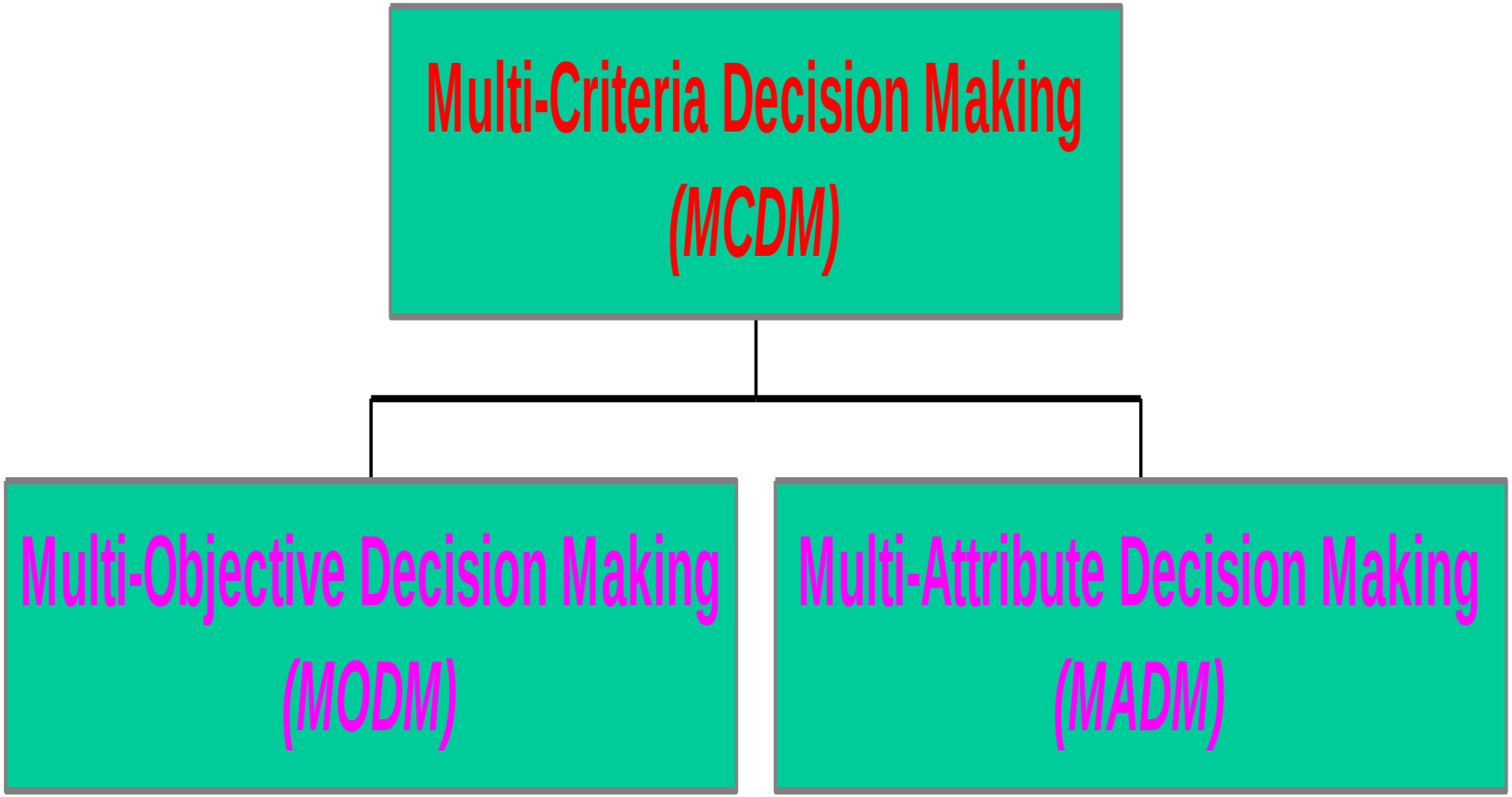
KULLIYYAH LEVEL AWARD

				Acad CGPA	Co-Cu CGPA	Co-Cu points	Best Stdnt Overall Acad=60% CoCu=40%	Best Stdnt Academic Acad=80% CoCu=20%	Best Stdnt Co-Cu Acad=40% CoCu=60%
1	1224142	Acc	Fatin Marina Zakaria	3.774	4.000	855	3.864	3.819	3.910
2	1225019	Acc	Ammar Fahmi Tajudin	3.753	4.000	1305	3.852	3.802	3.901
3	1227653	Acc	Muhammad Yusri Iskandar Naini	3.736	4.000	1960	3.842	3.789	3.894
4	1216905	Acc	Irfaan Coodraty	3.725	0.470	70	2.423	3.074	1.772
5	1312449	Acc	Ahmad Farhan Nazmi	3.683	4.000	835	3.810	3.746	3.873
6	1227204	Acc	Nurul Faten Ain Rusli	3.683	2.130	320	3.062	3.372	2.751
7	1229194	Acc	NurAini Farhanah Zulkepli	3.655	4.000	1595	3.793	3.724	3.862
8	1223380	Acc	Jamaliah Darwis	3.625	4.000	630	3.775	3.700	3.850
9	1223801	Acc	Muhammad Hazmi Anas	3.607	4.000	2090	3.764	3.686	3.843
10	1229153	Acc	Muhammad Shazil Rozmi	3.594	3.570	535	3.584	3.589	3.580
1	1326728	Buss	Nurfara Atikah Mohd Faisal	3.754	4.000	1090	3.852	3.803	3.902
2	1322672	Buss	Sharifah Amirah Syed Effendi Hakim	3.500	4.000	920	3.700	3.600	3.800
3	1325687	Buss	Nurul Asri Abd Manaf	3.407	0.570	85	2.272	2.840	1.705
4	1221895	Buss	Mohammad Syazwan Mohamed Shariff	3.382	2.130	320	2.881	3.132	2.631
5	1316841	Buss	Mohammad Saiful Islam	3.374	1.870	280	2.772	3.073	2.472
6	1312564	Buss	Noor Atiqa Yunus	3.371	4.000	765	3.623	3.497	3.748
7	1318274	Buss	Nurul Asyikin Muhammad	3.354	1.400	210	2.572	2.963	2.182
8	1312458	Buss	Intan Munirah Zakaria	3.344	4.000	720	3.606	3.475	3.738
9	1320546	Buss	Nor Atiqah Roslin	3.339	0.830	125	2.335	2.837	1.834
1	1316665	Isfin	Aziz Zainuddin	3.863	3.730	560	3.810	3.836	3.783
2	1319126	Isfin	Nur Diyana Najwa Mohd Affendi	3.665	4.000	1420	3.799	3.732	3.866
3	1222386	Isfin	Nurul Atthirah Ab Razak	3.653	1.070	160	2.620	3.136	2.103
4	1314206	Isfin	A'tiqah Mohd Zaki	3.575	4.000	1200	3.745	3.660	3.830
5	1321366	Isfin	Nurul Najwa Mat Rosdi	3.541	4.000	2065	3.725	3.633	3.816
6	1234780	Isfin	Munibah Salwani Murshid	3.501	0.330	50	2.233	2.867	1.598
7	1312540	Isfin	Sahar Amin	3.458	1.030	165	2.487	2.972	2.001
8	1315619	Isfin	Hamza Showkat Peer	3.456	0.530	80	2.286	2.871	1.700
9	1320133	Isfin	Muhammad Nazmi Ahmad	3.453	4.000	960	3.672	3.562	3.781

Job Selection Criteria

- Salary
- Job security
- Working environment
- Advancement opportunity
- Location
- Reputation

Classification of MCDM Problems



General form of MOLP

$$\text{Maximise } z_1 = c_{11}x_1 + c_{12}x_2 + \ldots\ldots + c_{1n}x_n$$

$$\text{Maximise } z_2 = c_{21}x_1 + c_{22}x_2 + \ldots + c_{2n}x_n$$

$$\vdots \qquad\qquad \vdots \qquad\qquad \vdots$$

$$\text{Maximise } z_k = c_{k1}x_1 + c_{k2}x_2 + \ldots . + c_{kn}x_n$$

subject to

$$a_{11}x_1 + a_{12}x_2 + \ldots.. + a_{1n}x_n \le b_1$$

$$a_{21}x_1 + a_{22}x_2 + \ldots\ldots + a_{2n}x_n \le b_2$$

$$\vdots \qquad\qquad \vdots \qquad\qquad \vdots$$

$$a_{m1}x_1 + a_{m2}x_2 + \ldots + a_{mn}xn \le b_m$$

$$x_1,\ x_2\ , \ldots\ldots\ldots x_n \ge 0$$

MODM problems arises in design, modelling, and planning of many complex resource allocation systems in the area of:

- Industrial production
- Urban transportation
- Health
- Layout and landscaping of new cities
- Energy production and distribution
- Wild life management
- Operations and controls of firms
- Agriculture, etc, etc.

MODM Problems Methods

- Goal Programming
- Fuzzy Programming
- Utility Function Method
- Global Criterion Method
- Lexicographic Method

An Example of A Multi-Attribute Decision Making (MADM) Problem

	Salary	Location	Working Environment
Job # 1	7,000	good	Not Satisfactory
Job # 2	6,000	bad	Very good
Job # 3	5,000	Very good	Average

General formulation of a MADM problem

	C_1	C_2	$\cdots$	C_n
A_1	x_{11}	x_{12}	$\cdots$	x_{1m}
A_2	x_{21}	x_{22}	$\cdots$	x_{2m}
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
A_n	x_{n1}	x_{n2}	$\cdots$	x_{nm}

Methods to solve MADM Problems

- ELECTRE (1968)
- Simple Additive Weighting Method(1969)
- Elimination by Aspects (1971)
- LINMAP (1973)
- Permutation Method (1976)
- Multi Attribute Utility Theory (1976)
- Linear Assignment Method ((1977)
- **Analytic Hierarchy Process (1977)**
- TOPSIS (1980)

AHP

Over the last three decades, managers, researchers, practitioners, management consultants and many other people have used the Analytic Hierarchy Process (AHP) to make decisions or to prioritize a set of factors in many areas of management.

Perhaps, the most appealing reason for the method's widespread use is its simplicity in application. Further, AHP can deal with subjective factors in decision making in a logical way. Number of real world applications of AHP is simply numerous.

AHP Applications areas (a partial list)

Accounting
Architecture
Banking
Conflict Analysis
Energy
Education
Finance
Forecasting
Health
Marketing
Military
Operations Management
Politics
Quality management
R & D Management
Resource Allocation
Risk Analysis
Sociology
Sports
Strategic Management
Technology
Transportation

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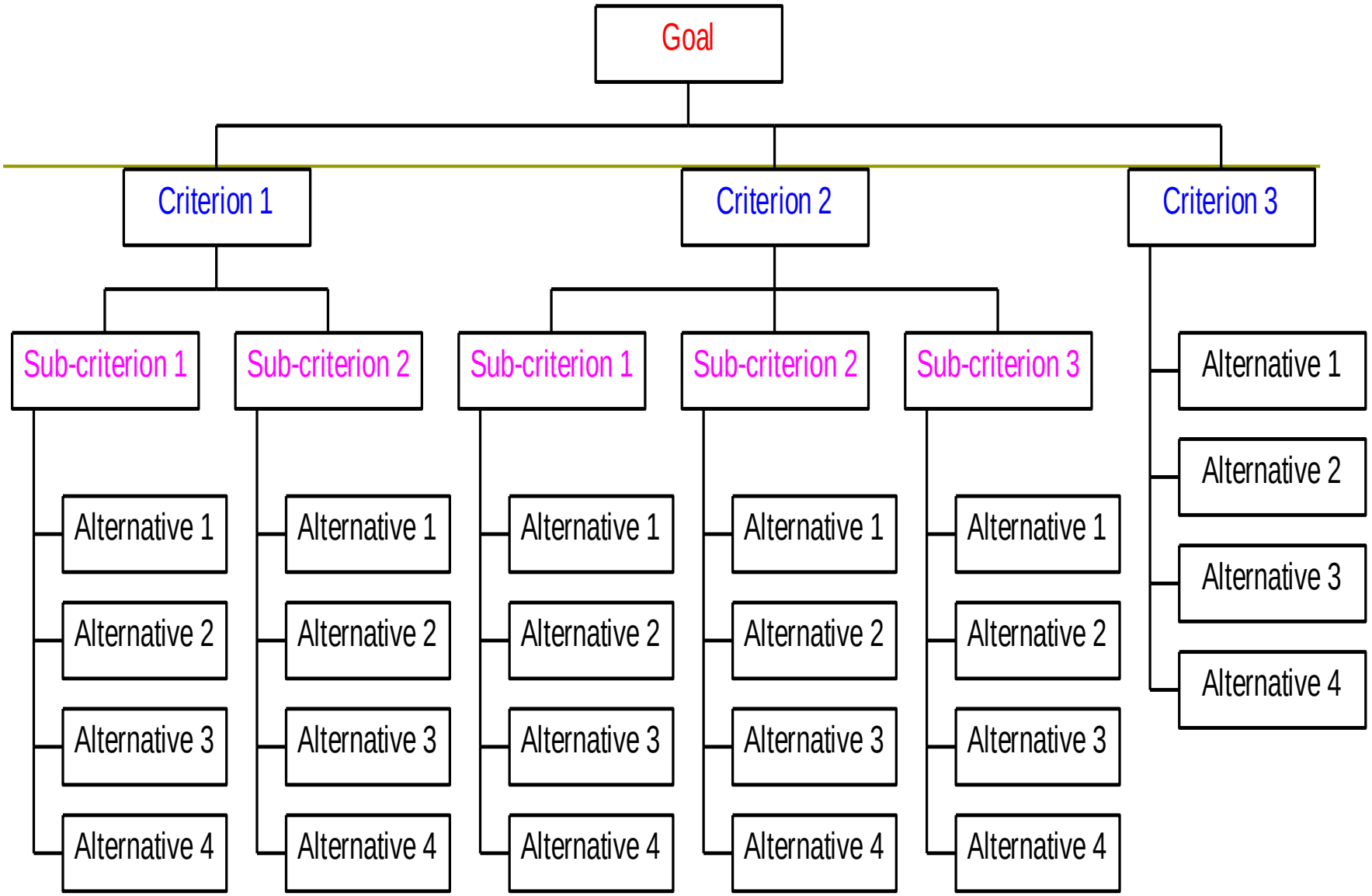
AHP is applicable in…

- To prioritise a set of factors (Prioritisation)
- To rank a set of factors/alternatives (Ranking
- To select the best alternative from a number of available alternatives (Selection)
- To evaluate a set of alternatives (Evaluation)
- To develop a hierarchical model… (model development)


Goal
Criterion 1
Criterion 2
Criterion 3
Sub-criterion 1
Sub-criterion 2
Sub-criterion 1
Sub-criterion 2
Sub-criterion 3
Alternative 1
Alternative 2
Alternative 3
Alternative 4
Alternative 1
Alternative 2
Alternative 3
Alternative 4
Alternative 1
Alternative 2
Alternative 3
Alternative 4
Alternative 1
Alternative 2
Alternative 3
Alternative 4
Alternative 1
Alternative 2
Alternative 3
Alternative 4
Alternative 1
Alternative 2
Alternative 3
Alternative 4

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General Form of A Pairwise Comparison Matrix

$A =$

	C_1	C_2	C_n
C_1	a_{11}	a_{12}	a_{12}
C_2	a_{21}	a_{22}	a_{22}
C_n	a_{n1}	a_{n2}	a_{nn}

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Semantic Interpretation of the ratios in the comparison matrices

Verbal judgment of importance	Rating
Equally important	**1**
Equally to moderately important	2
Moderately important	**3**
Moderately to strongly important	4
Strongly important	**5**
Strongly to very strongly important	6
Very strongly important	**7**
Very strongly to extremely important	8
Extremely important	**9**
Note: $a_{ji} = 1/a_{ij}$	

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Criteria Pairwise Comparison Matrix

	C1	C2	C3	C4	C5	C6	Weights
C1	1	1	1	4	1	½	0.159
C2	1	1	2	4	1	½	0.184
C3	1	1/2	1	5	3	½	0.198
C4	1/4	1/4	1/5	1	1/3	1/3	0.049
C5	1	1	1/3	3	1	1	0.155
C6	2	2	2	3	1	1	0.253

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AHP Software

- Superdecision (www.superdecisions.net)
- Expertchoice (www.expertchoice.com)
- Excel adds-in (http://bpmsg.com/ahp-excel-template/)

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Human Resource Management

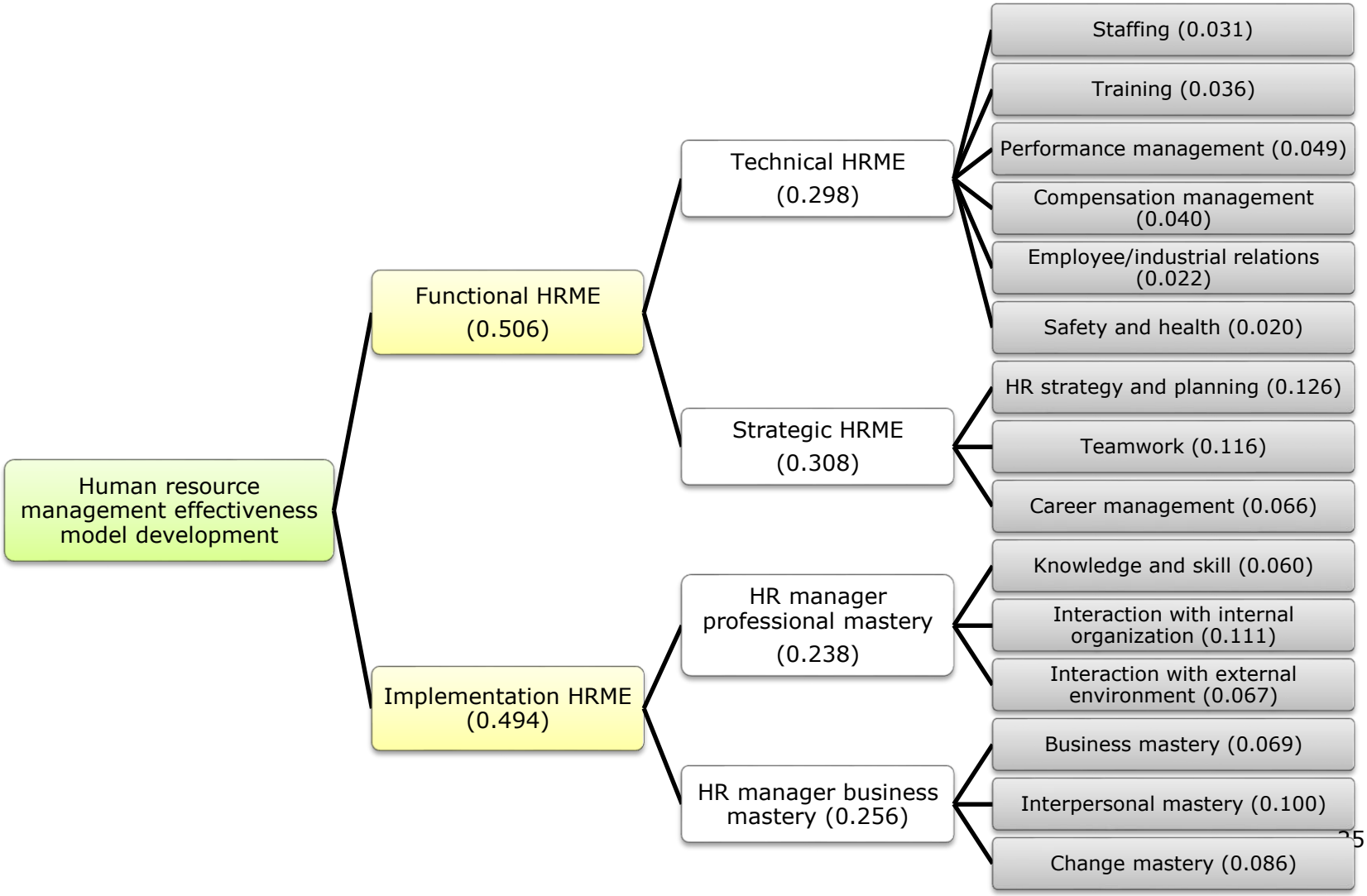
- Developing A Human Resource Management Effectiveness Model

- Selection of Research Officers in the Saudi-Arabian Ministry of Foreign Affairs

Developing A Human Resource Management Effectiveness Model

- Human resources play extremely vital role for the success of any organization. An organization that has a superior HRM practices may outperform its competitors in the marketplace.
- The HRM effectiveness model hierarchy starts with two HRM effectiveness dimensions namely Functional HRME and Implementation HRME.
- They are further detailed into a number of secondary dimensions and finally into a number of indicators.

Hierarchy


Human resource management effectiveness model development
Functional HRME (0.506)
Implementation HRME (0.494)
Technical HRME (0.298)
Strategic HRME (0.308)
HR manager professional mastery (0.238)
HR manager business mastery (0.256)
Staffing (0.031)
Training (0.036)
Performance management (0.049)
Compensation management (0.040)
Employee/industrial relations (0.022)
Safety and health (0.020)
HR strategy and planning (0.126)
Teamwork (0.116)
Career management (0.066)
Knowledge and skill (0.060)
Interaction with internal organization (0.111)
Interaction with external environment (0.067)
Business mastery (0.069)
Interpersonal mastery (0.100)
Change mastery (0.086)

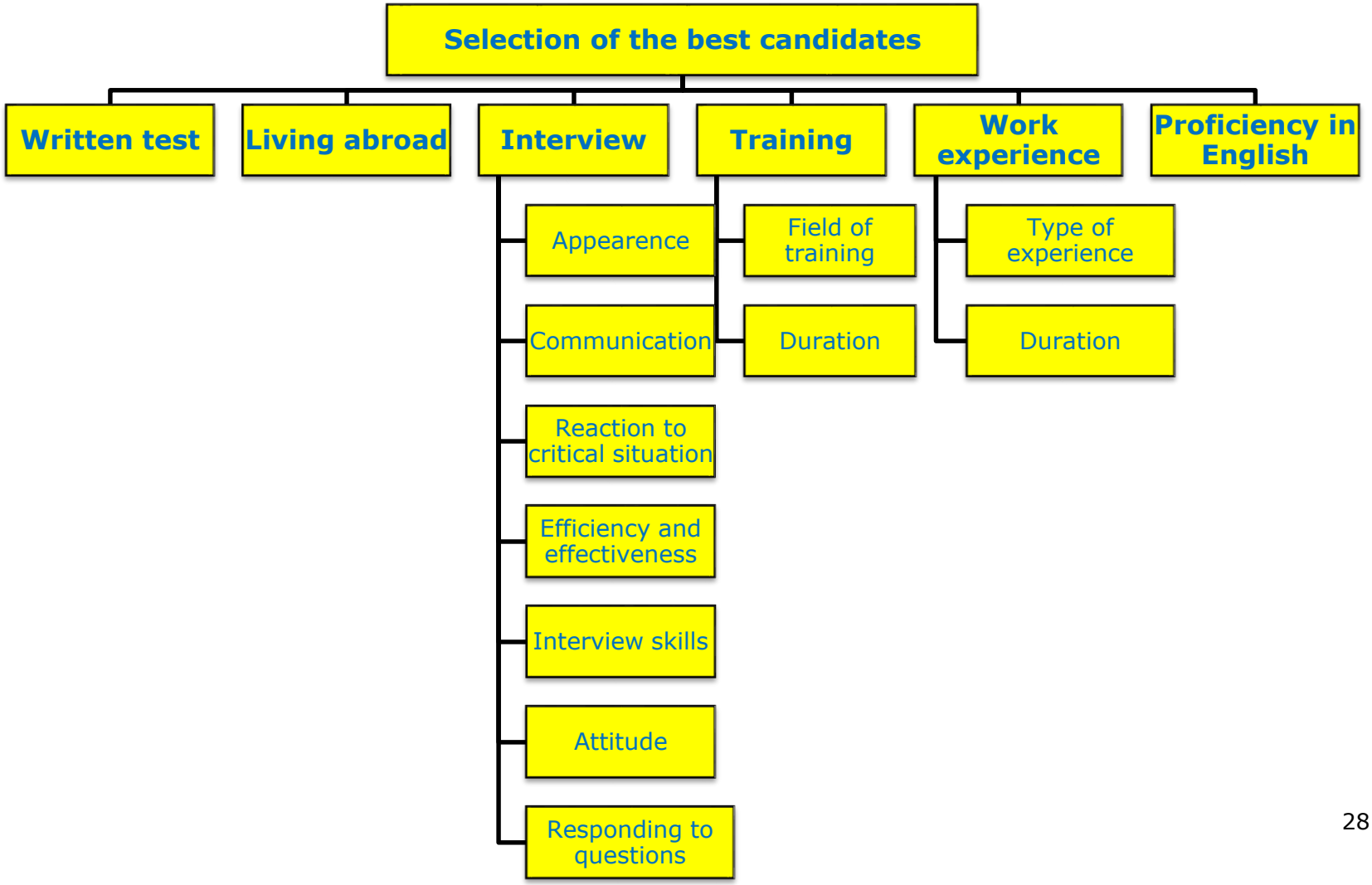
Selection of Research Officers in the Saudi Arabian Ministry of Foreign Affairs

- Traditionally, personnel selection is done using person's curriculum vitae and performance in the job interview. Though this method of selection is widely used in practice, but inherently the selection process is fraught with many limitations.
- Personnel selection is essentially a multi-criteria decision making problem where the criteria are quantitative as well as qualitative.
- There is no convincing proof that the traditional method mentioned above integrates the performance of the candidate on quantitative and qualitative criteria in a meaningful way.
- It is not uncommon to see controversies after the selection is surfaced. It has been found many times that the selection made in the above manner is wrong.
- The AHP is a perfectly suitable method to aid managers in personnel selection decision making, especially, it helps construct decision hierarchy by analysing an arguably unstructured decision making problem.

Cont..

- The present authors have shown how AHP can be applied effectively in selecting 20 international research officers in the Saudi Arabian Ministry of Foreign Affairs (MOFA).
- Initially, the ministry received 1,800 applications from which 350 were short-listed.
- A potential problem was faced on how to select 20 candidates out of 350 potential applications.
- AHP was found to be handy tool in overcoming the problem. In close consultation with the relevant ministry officers, the researchers identified the main criteria for the selection, which are (1) Performance in written test (2) Experience in living in a foreign country (3) Personality interview, (4) Work experience, (5) Training, and (6) Proficiency in English language.

Hierarchy


Selection of the best candidates
Written test
Living abroad
Interview
Training
Work experience
Proficiency in English
Appearence
Communication
Reaction to critical situation
Efficiency and effectiveness
Interview skills
Attitude
Responding to questions
Field of training
Duration
Type of experience
Duration

Synthesis

Table 1: Priority of the criteria and subcriteria

Criteria	Subcriteria	Priority
Written test		**0.1640**
Living abroad		**0.0410**
Personality		**0.4524**
	Appearance	0.0631
	Communication	0.2209
	Efficiency and effectiveness	0.2316
	Reaction to criteria situation	0.3367
	Skills and attitude	0.0584
	Responding to questions	0.0892
Work experience		**0.2210**
	Type of experience	0.2000
	Duration	0.8000
Training		**0.0433**
	Field of training	0.2000
	Duration	0.8000
Proficiency in English		**0.0784**

Total Quality Management

- Whether or Not to Implement ISO 9000 Quality Management System
- Improving Service Quality at Restaurants

Whether or Not to Implement ISO 9000 Quality Management System

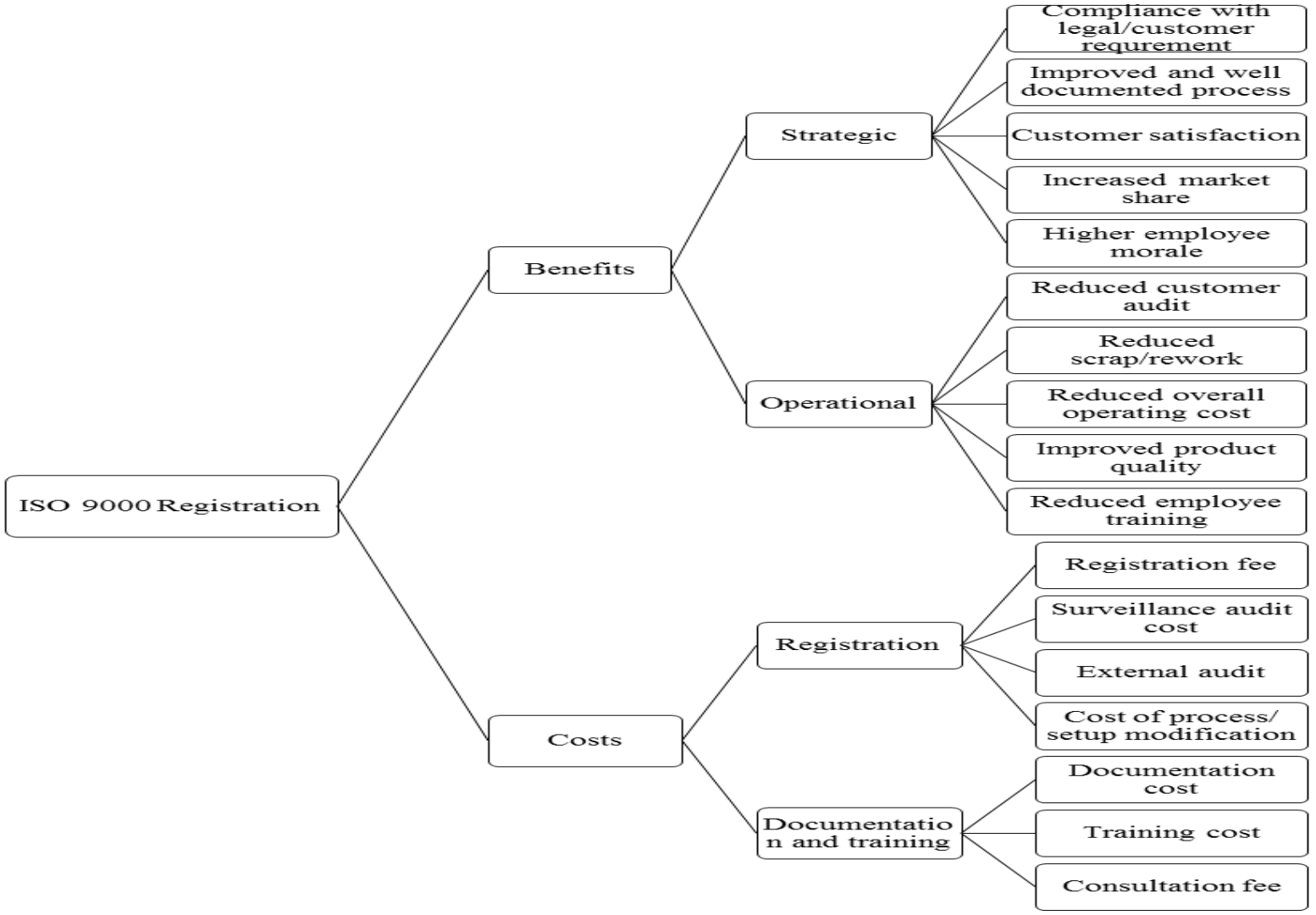
- During the last two decades, registration in ISO 9000 quality management system (QMS) has been immensely popular. More than 150 countries in the world have adopted ISO 9000 as their national QMS.
- Despite having many critics of ISO, the system has been hailed as a tool to improve and remain consistent in managing quality.
- According to a survey, average total cost involved in the entire registration process is $261,000, whereas the annual savings has been found to be about $179,000.
- Indeed, to decide whether or not a company should go for registration, we need to perform a cost-benefit analysis.

  Major costs involved are: training, documentation, process modification, consultation fee, registration fee and so on.

Cont..

- On the other hand, the benefits are many such as improved product quality and productivity, reduced operating costs due to improved processes, reduced rework and scrap, improved customer relation, etc. Note that many of the benefits are intangibles. AHP has been applied to deal with all the costs and benefits attributes and making the decision whether to go for the registration.
- The authors' comment on AHP application is put forward here (p. 212): *"The analytical hierarchy process (AHP) organizes feelings, intuition, and logic in a structured approach to decision making, which proves beneficial in an environment that has predominantly intangible attributes. The AHP enables one to structure a system and its environment into mutually interacting parts and then to synthesize them by measuring and ranking the impact of these parts on the entire system. Also by providing a new logic for synthesis, wherein it incorporates consistency indicators in making pairwise comparisons, this structured approach to decision making eliminates much of the guesswork and confusion in analyzing the system"*.

Hierarchy


ISO 9000 Registration
Benefits
Strategic
Compliance with legal/customer requirement
Improved and well documented process
Customer satisfaction
Increased market share
Higher employee morale
Operational
Reduced customer audit
Reduced scrap/rework
Reduced overall operating cost
Improved product quality
Reduced employee training
Costs
Registration
Registration fee
Surveillance audit cost
External audit
Cost of process/ setup modification
Documentation and training
Documentation cost
Training cost
Consultation fee

Synthesis

Table 1: Priority weights for benefits

Strategic benefit attributes	LCR	IDP	CS	MS	EM	Alternative priority weight
Weights	0.047	0.477	0.312	0.057	0.106	
Alternative						
Implement	0.833	0.876	0.857	0.667	0.857	0.8532
Do not implement	0.167	0.125	0.143	0.333	0.143	0.1462
Operational benefit attributes						
	CA	SR	OC	PQ	ET	
Weight	0.064	0.108	0.419	0.361	0.047	
Alternative						
Implement	0.800	0.750	0.833	0.667	0.833	0.7618
Do not implement	0.200	0.250	0.167	0.333	0.167	0.2481
Benefit attribute						
	Strategic	Operational				
Weights	0.250	0.750				
Alternative						
Implement	0.8832	0.7618				0.7847
Do not implement	0.1462	0.2418				0.2179

Notes: LCR = compliance with legal/customer requirement; IDP = improved and well documented process; CS = customer satisfaction; MS = increase market share; EM = higher employee morale; CA = reduced customer audit; SR = reduced scrap work; OC = reduced overall operating cost; PQ = improved product quality; ET = reduced employee training

Table 2: Priority weights for costs

Registration					**Alternative priority weight**
	RF	SA	EA	PM	
Weights	0.055	0.385	0.412	0.148	
Alternative					
Implement	0.833	0.750	0.667	0.500	0.6833
Do not implement	0.167	0.250	0.333	0.500	0.3166
Document/training cost					
	DC	TC	CF		
Weight	0.474	0.474	0.053		
Alternative					
Implement	0.750	0.750	0.500		0.7375
Do not implement	0.250	0.250	0.500		0.2635
Cost attribute					
	Registration	Documentation/training			
Weights	0.500	0.500			
Alternative					
Implement	0.6833	0.7375			0.7104
Do not implement	0.3166	0.2635			0.2901

Notes: RF = Registration fee; SA = Surveillance audit; EA = External audit; PM = Process modification cost; DC = Documentation cost; TC = Training cost; CF = Consulting fee; Implement = Implement ISO 9000; Do not Implement = Do not implement ISO 9000

Table 3:Benefit-cost ratio

	Implement ISO 9000	Not to implement ISO 9000
Benefit	0.7847	0.2179
Cost	0.7104	0.2901
Benefit/cost ratio (B/C)	1.105	0.7511

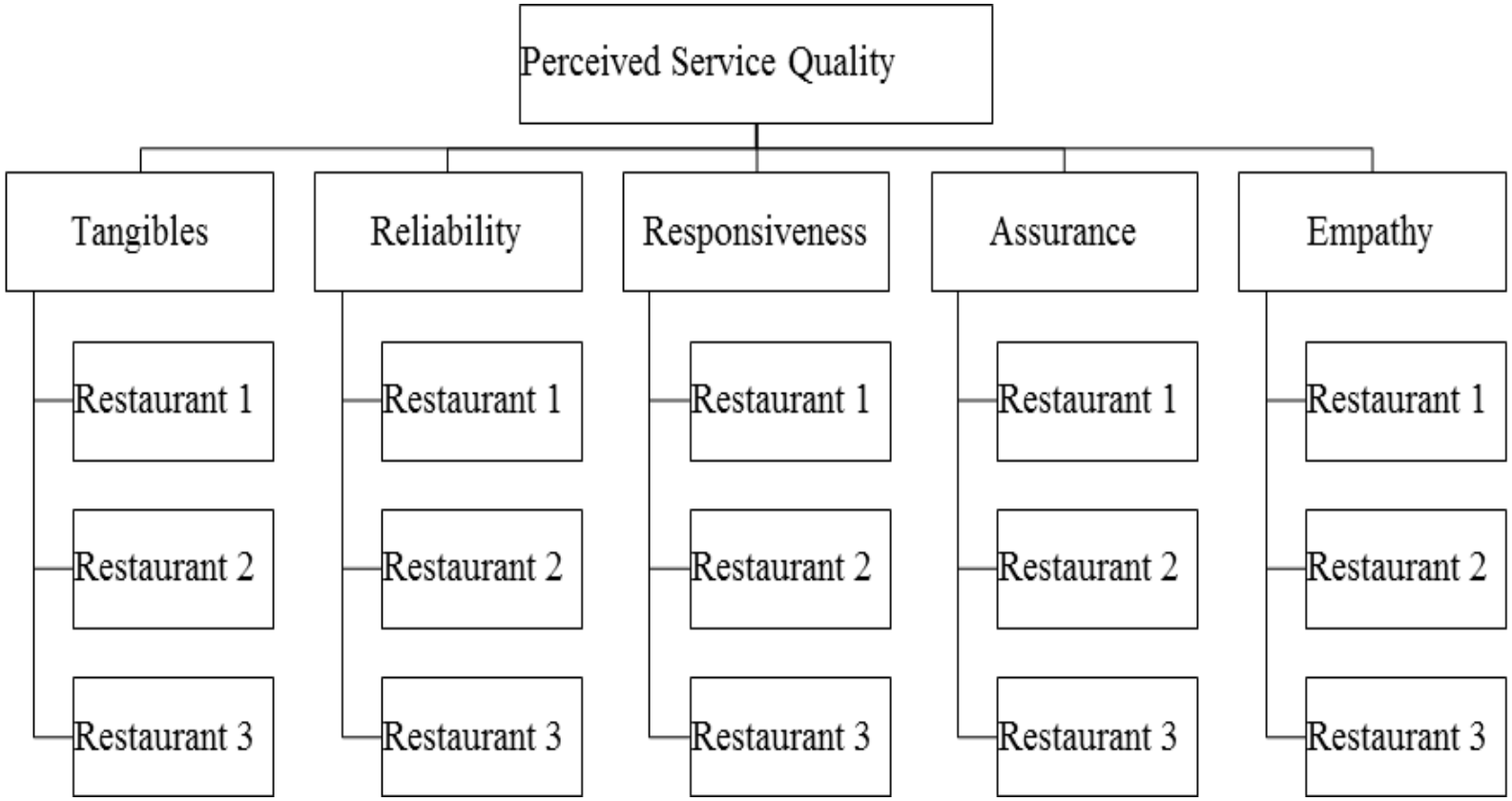
Improving Service Quality at Restaurants

- In the stiff competitive marketplace, perhaps companies have no other alternative, but to improve their quality of service in the continuous basis. Failing to do so, companies may risk to be forlorn by their customers. How to measure quality of service?
- A number of methods are available such as customer service audits, gap analysis, SERVQUAL, SERPERF, critical incident technique, etc.
- A common feature of all these methods is that all of them focus on measuring internal quality without referring to competition in the market.

Cont..

- Two questions are of paramount importance in this regards: (1) which service areas require further improvement? (2) what opportunities exist for service improvement in relation to their competitors?
- AHP has been proposed to answer both the questions. Seventy two customers' responses were used in deriving the priorities.
- The authors' comment on the application of AHP goes like this: "*AHP is used as a comparative service-improvement technique for two reasons. First, the AHP technique allows pairwise comparisons to be made among the alternatives with respect to the service dimensions. This provides a more meaningful analysis for developing a competitive set of service attributes that will satisfy customers and assist the service provider in outperforming its competitors. Second, to determine comparative service performances, AHP requires the collection of only one set of data – as opposed to several sets with the adapted SERVQUAL instrument*".

Hierarchy


Perceived Service Quality
Tangibles
Reliability
Responsiveness
Assurance
Empathy
Restaurant 1
Restaurant 2
Restaurant 3
Restaurant 1
Restaurant 2
Restaurant 3
Restaurant 1
Restaurant 2
Restaurant 3
Restaurant 1
Restaurant 2
Restaurant 3
Restaurant 1
Restaurant 2
Restaurant 3

Synthesis

Table 1: Ranking of mean importance by service dimensions

Service dimensions	Mean importance	Ranking
Tangibles	0.21	2
Reliability	0.16	4
Responsiveness	0.15	5
Assurance	0.18	3
Empathy	0.29	1

Table 2: Mean overall satisfaction scores

	Mean weighted satisfaction scores		
Dimensions	McDonald's	Burger King	Harvey's
Tangibles	0.31	0.23	0.46
Reliability	0.15	0.26	0.59
Responsiveness	0.25	0.27	0.48
Assurance	0.17	0.24	0.60
Empathy	0.39	0.37	0.24
Mean overall satisfaction scores	0.30	0.31	0.39
Ranking based on overall satisfaction scores	3	2	1
Note: Sample size is 62.			

Strategic Management

- Determining Key Capabilities of a Firm

Determining Key Capabilities of A Firm

- Key capabilities are defined as core competencies of a firm that can provide it competitive advantage in the marketplace.
- A capability must be strategically viable which can play an important role in realizing the mission of the firm.
- Normally, various kinds of organizational resources such as physical assets, intellectual assets, cultural assets provide a firm develop its capabilities.
- The authors have outlined a 3-step procedure to rank a firm's capabilities. These steps are: (1) Determining performance measures and mapping firm capabilities, (2) Evaluating capabilities on the basis of the extent of their contribution to realize organizational goals, (3) Determining key capabilities.

Cont...

- The evaluation is carried out on the basis of two different types of performance measures – financial and non-financial.
- Financial measures are sales growth, operating profit, and return on capital employed; on the other hand, the non-financial measures include market share, new product introduction and customer satisfaction.

Hierarchies

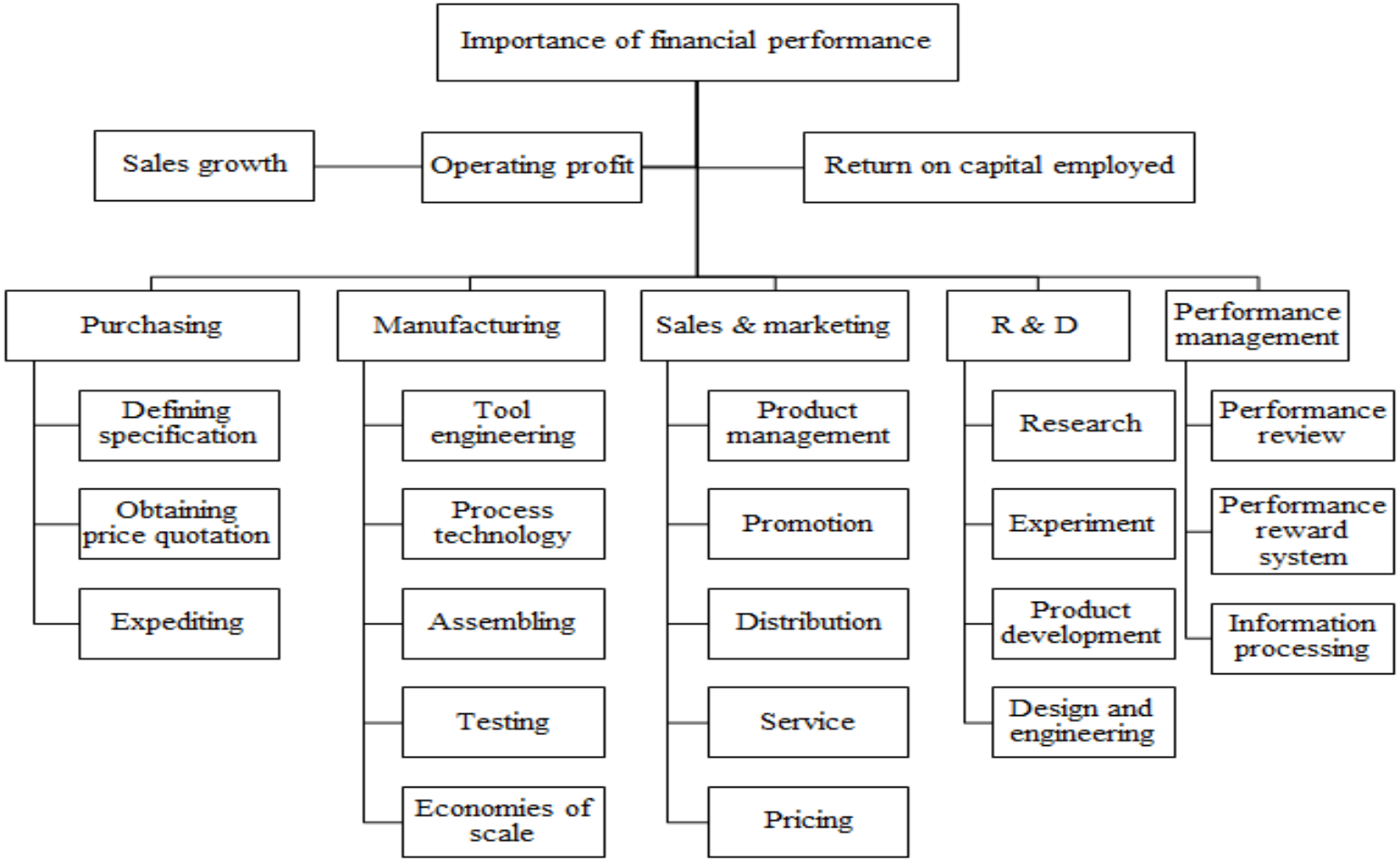


Figure 1: The hierarchy for financial measures

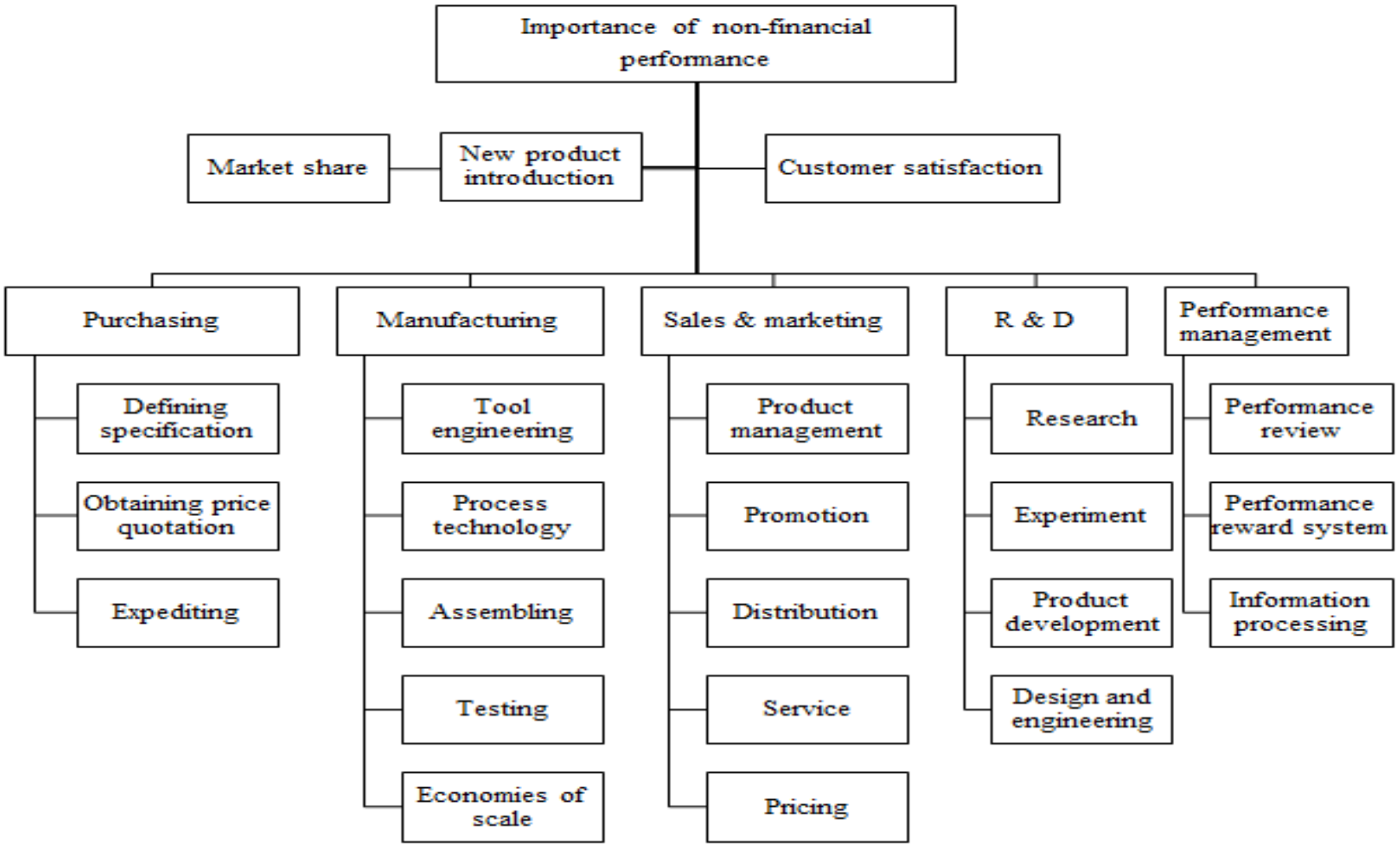


Figure 2: The hierarchy for non-financial measures

Synthesis

Table 1 Priorities of the measures

Financial	Priority	Non-financial	Priority
Operating profit	0.290	Market share	0.064
Sales growth	0.055	New product introduction	0.237
Return on capital employed	0.655	Customer satisfaction	0.699

Table 2: Global priorities of the capability alternatives

Operational capability	Priority weights of financial evaluation	Priority weights of non-financial evaluation
Purchasing		
Defining specification	0.0596	0.0144
Obtaining price quotation	0.0149	0.0036
Expediting	0.0149	0.0036
Manufacturing		
Process technology	0.1408	0.0968
Economies of scale	0.1056	0.0726
Tool engineering	0.0352	0.0242
Assembling	0.0352	0.0242
Testing	0.0352	0.0242
Sales and marketing		
Product management	0.0354	0.0354
Service	0.0354	0.0354
Pricing	0.0708	0.0708
Promotion	0.0177	0.0177
Distribution	0.0177	0.0177
R&D		
Product development	0.0230	0.0548
Research	0.0115	0.0274
Design and engineering	0.0115	0.0274
Experiment	0.0230	0.0548
Performance management		
Performance review	0.0828	0.1084
Performance reward system	0.0207	0.0271
Information processing	0.0207	0.0271

Operations Management

- An Industrial Location Decision
- Comparing the Performances of Manufacturing Departments/Factories

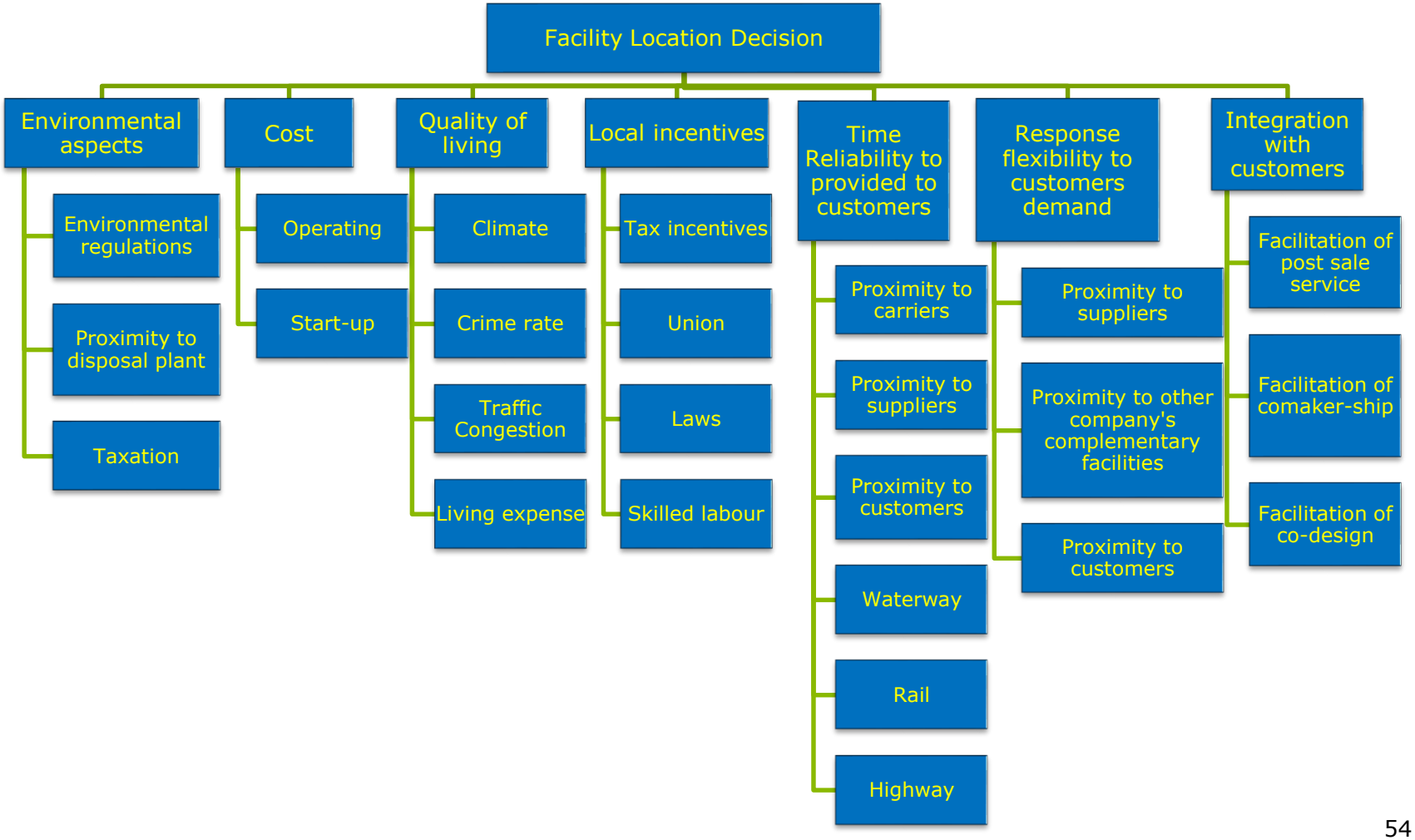
An Industrial Location Decision

- One of the strategic decisions made by senior managers of a firm is where to locate its facilities/new branches.
- The decision has long term implications in profitability of the firm. Usually, this type of decisions is to be made keeping long term interest of the firm in mind.
- This is because today's optimal decision in location may turnout to be investment blunder tomorrow. Therefore, a thorough analysis of the problem is an imperative.
- AHP has been proposed to deal with the issue and also the method has been successfully applied in many location decision scenarios.
- In particular, this application pertains to a medium-sized manufacturer of mechanical components for the bottling machinery industry which plans to relocate its current manufacturing and distribution facility to a new site.

Cont…

- The seven major criteria considered in the present case are the following: environmental, cost, quality of living, local incentives, time reliability provided to the customers, response flexibility to the customers' demand, and integration with the customers.

Hierarchy


Facility Location Decision
Environmental aspects
Environmental regulations
Proximity to disposal plant
Taxation
Cost
Operating
Start-up
Quality of living
Climate
Crime rate
Traffic Congestion
Living expense
Local incentives
Tax incentives
Union
Laws
Skilled labour
Time Reliability to provided to customers
Proximity to carriers
Proximity to suppliers
Proximity to customers
Waterway
Rail
Highway
Response flexibility to customers demand
Proximity to suppliers
Proximity to other company's complementary facilities
Proximity to customers
Integration with customers
Facilitation of post sale service
Facilitation of comaker-ship
Facilitation of co-design

Synthesis

Table 1: Local and global priorities of the criteria and subcriteria

Criterion	Sub-criterion	Local Priority	Total Priority
Environmental aspects			0.042
	Environmental regulations	0.196	0.008
	Proximity to disposal plants	0.311	0.013
	Taxation	0.493	0.021
Cost			0.206
	Operating cost	0.440	0.091
	Start-up cost	0.560	0.115
Quality of living			0.023
	Climate	0.070	0.002
	Crime rate	0.498	0.012
	Traffic congestion	0.083	0.002
	Living expense	0.348	0.008
Local incentives			0.059
	Tax incentives	0.147	0.010
	Union	0.206	0.012
	Laws	0.097	0.006
	Skilled labor	0.523	0.031
Time reliability provided to customers			0.163
	Proximity to carriers	0.124	0.020
	Proximity to suppliers	0.350	0.057
	Proximity to customers	0.296	0.048
	Waterway	0.038	0.006
	Rail	0.093	0.015
	Highway	0.099	0.016
Response flexibility to customers' demands			0.210
	Proximity to suppliers	0.540	0.113
	Proximity to other company's complementary facilities	0.297	0.062
	Proximity to customers	0.163	0.034
Integration with customers			0.295
	Facilitation of post-sale service	0.455	0.134
	Facilitation of co-makership	0.091	0.027
	Facilitation of co-design	0.455	0.134

Table 2: Final scores of the alternative locations

Alternative site	Score
Location 1	0.377
Location 2	0.261
Location 3	0.362

Comparing Performances of Manufacturing Departments/Factories

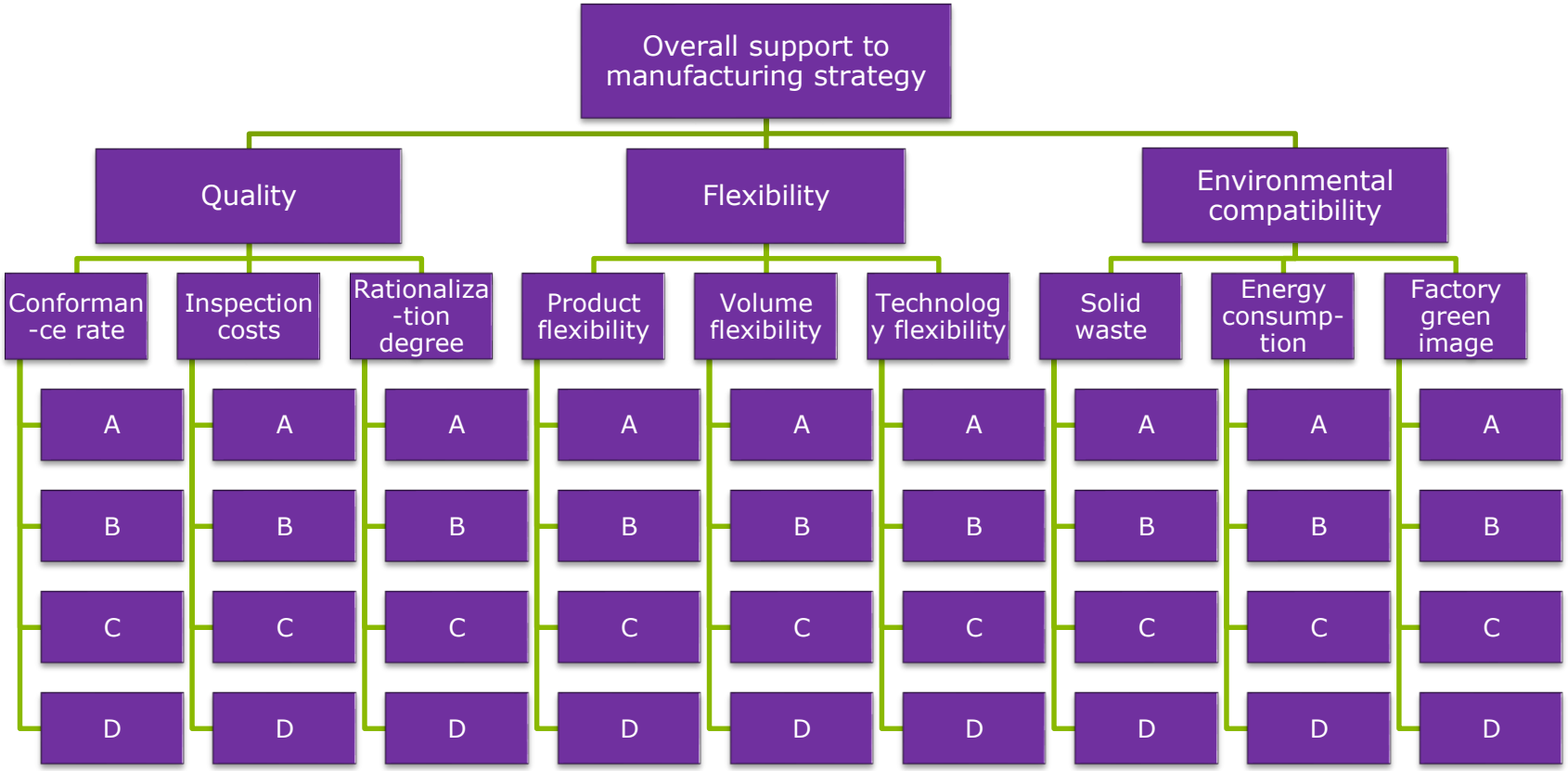
- Measuring performance of a manufacturing company essentially involves financial as well as non-financial criteria.
- There are at least two problems in dealing with non-financial measures: selection of a proper set of measures capable of assessing the performance and secondly how to pool together those measurements expressed in heterogeneous units.
- While the first one has been dealt elaborately in the literature, but there is a dearth of discussions regarding the second issue.
- The present author has made a modest attempt to deal with the second issue. After forming the hierarchy of the measurement model he comments (p. 106):

"In the case of manufacturing performance measurement, the overall objective is the support provided by each factory to manufacturing strategy; the criteria are the manufacturing competitive priorities; the subcriteria are the operating measures included in the manufacturing performance measurement system; the decision alternatives are the factories that managers want to compare".

Cont…

- Therefore, the present work pertains to measuring factory performances to know which factory contributes the maximum in contributing to its manufacturing strategy.
- Clearly, the criteria set used are very heterogeneous in nature and AHP has been found to be very suitable in carrying out the present exercise of performance measurement.

Hierarchy


Overall support to manufacturing strategy
Quality
Flexibility
Environmental compatibility
Conformance rate
Inspection costs
Rationalization degree
Product flexibility
Volume flexibility
Technology flexibility
Solid waste
Energy consumption
Factory green image
A
B
C
D

Synthesis

Table 1: Weights of the criteria and subcriteria

Criteria	Subcriteria	Weights
Quality		0.682
	Conformance rate	0.669
	Inspection costs	0.088
	Rationalization degree	0.243
Flexibility		0.103
	Product flexibility	0.455
	Technology flexibility	0.455
	Volume flexibility	0.090
Environment compatibility		0.215
	Solid waste	0.648
	Energy conservation	0.122
	Green image	0.230

Table 2: Composite priorities of the alternatives

Alternative	Quality	Flexibility	Environment	Overall
A	0.247	0.144	0.068	0.194
B	0.217	0.350	0.440	0.279
C	0.192	0.303	0.192	0.192
D	0.344	0.233	0.335	0.335

Marketing Management

- Factors Influencing Choice of Self-Service Technology Channels in Retail Banking
- Determining Consumer Preference on Products

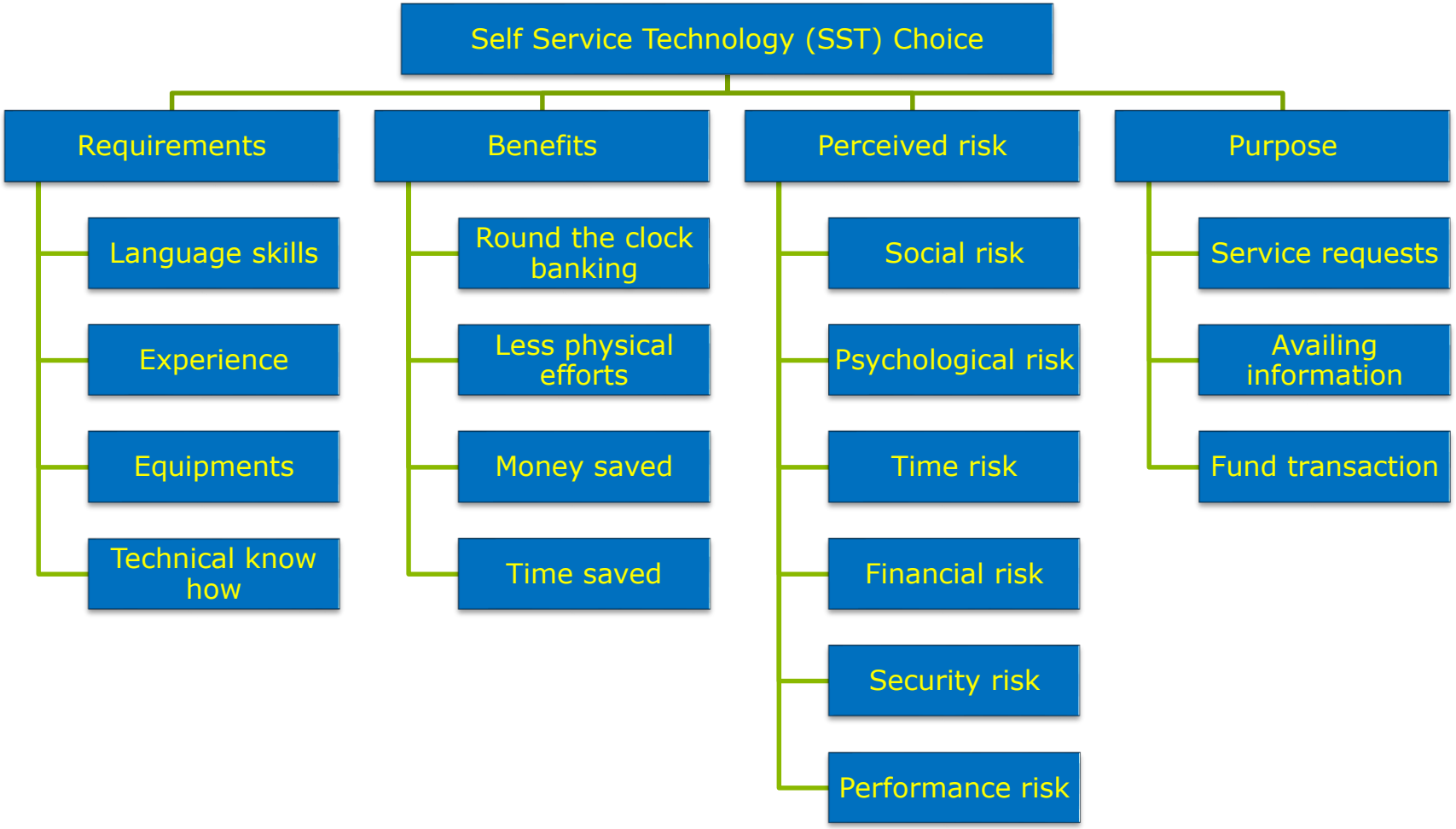
Factors Influencing Choice of Self-Service Technology Channels in Retail Banking

- Retail banking services have been widely facilitated by the introduction of a number of self-service channels including ATMs, internet banking, and mobile banking.
- But do the customers use these technologies equally for bank transactions? Perhaps no.
- The use of the various channels depends upon a number of factors which determine the selection of a specific self-service technology (SST) for a specific purpose.
- Perceived risk is commonly associated with usage of technology, especially for retail banking. Based upon the existing literature, SST channel choice is influenced by four factors: purpose, perceived risk, benefits, and equipment & skill requirement.
- Forty customers of a nationalized bank participated in deriving the priorities of the influencing factors.

Alternatives

- ATM
- Internet banking
- Mobile banking

Hierarchy


Self Service Technology (SST) Choice
Requirements
Language skills
Experience
Equipments
Technical know how
Benefits
Round the clock banking
Less physical efforts
Money saved
Time saved
Perceived risk
Social risk
Psychological risk
Time risk
Financial risk
Security risk
Performance risk
Purpose
Service requests
Availing information
Fund transaction

Synthesis

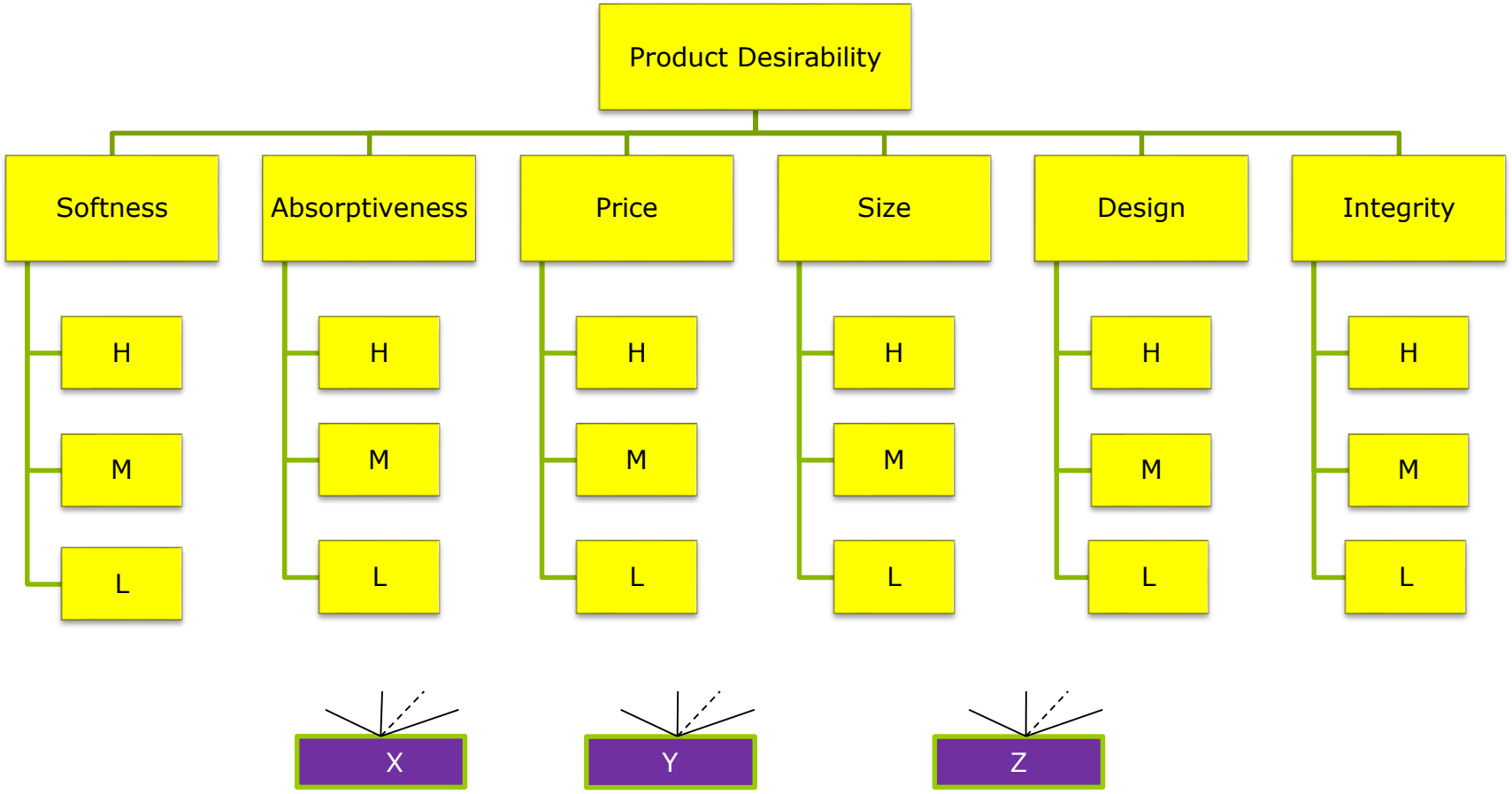
Table 1: Priorities of the factors and the three alternatives

	Purpose (0.098)	Perceived risk (0.259)	Benefits (0.592)	Requirements (0.049)	Overall priorities
ATM	0.198	0.662	0.313	0.66	0.408
Internet banking	0.508	0.178	0.327	0.16	0.297
Mobile banking	0.291	0.14	0.355	0.172	0.283

Determining Consumer Preference on Products

- A certain firm wants to determine consumer preferences for its three different kinds of paper towel.
- The attributes considered most relevant from the consumer's perspective are (1) softness, (2) absorptiveness, (3) price, (4) size, (5) design, and (6) integrity.
- The three kinds of paper towel, X, Y, and Z, possess all these attributes, but at different levels of intensity: high (H), medium (M), and low (L).
- Given the consumer's "bounded rationality" – that is, the fact that consumers do not act on perfect or complete information and are satisfied with less than the economically most rational choice – we can best distinguish among the attributes by dividing them into this small number of intensity categories.

Hierarchy


Product Desirability
Softness
Absorptiveness
Price
Size
Design
Integrity
H
M
L
H
M
L
H
M
L
H
M
L
H
M
L
H
M
L
X
Y
Z

Synthesis

Table 1: Priorities of the attributes

	(0.0570) Softness	(0.1679) Absorp.	(0.3837) Price	(0.1002) Size	(0.0269) Design	(0.2643) Integrity
H	0.7257	0.7608	0.0480	0.6267	0.1786	0.7608
M	0.2122	0.1912	0.1912	0.2797	0.7089	0.1912
L	0.0621	0.0480	0.7608	0.0936	0.1125	0.0480

Table 3: Weighted overall product attribute perception

	H-soft	H-absorp.	L-price	H-size	M-design	H-integrity	Overall
X	0.0397	0.0972	0.0285	0.0348	0.0104	0.1842	0.3949
Y	0.0121	0.0640	0.0804	0.0219	0.0095	0.0639	0.2519
Z	0.0037	0.0105	0.2834	0.0277	0.0057	0.0221	0.3532

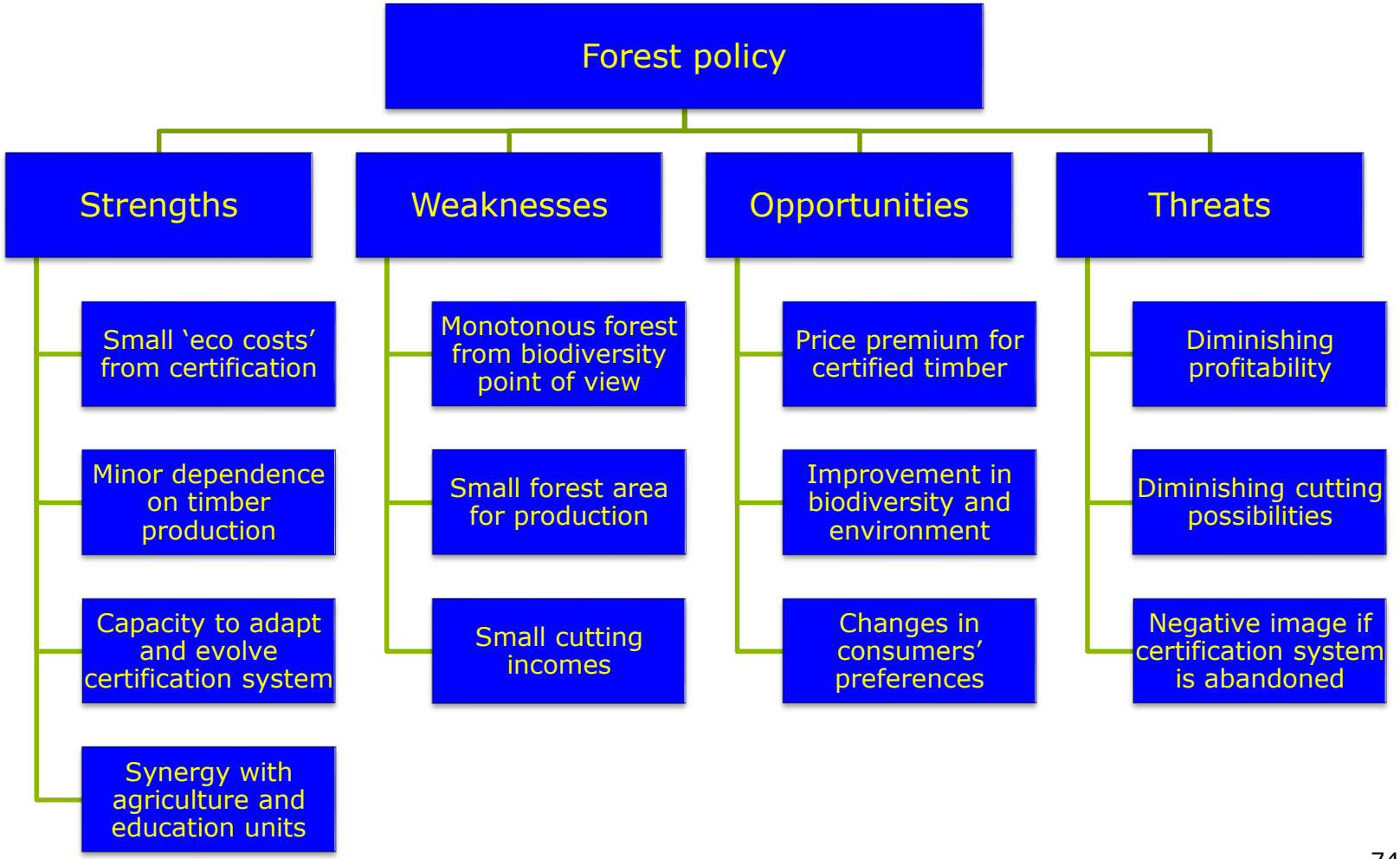
Environmental Management

- Prioritizing Factors in SWOT Analysis for a Finish Forestry Firm

Prioritizing Factors in SWOT Analysis for A Finish Forestry Firm

- SWOT (strength, weakness, opportunity, and threats) analysis is common in many organizations.
- However, it is to be noted that merely identifying the factors in SWOT analysis is not sufficient, rather prioritization of the factors is also important in order to enhance the usability of the tool.
- Prioritization provides the factors that are more important compared to others and hence these can be considered as *critical success factors*.
- A firm's performance with respect to these can be compared with its competitors. AHP has been applied to derive the weights of the SWOT factors for a timber company in Finland.
- In particular, the decision has been deliberated whether this company should seek certification in its forest planning.

Hierarchy


Forest policy
Strengths
Weaknesses
Opportunities
Threats
Small 'eco costs' from certification
Minor dependence on timber production
Capacity to adapt and evolve certification system
Synergy with agriculture and education units
Monotonous forest from biodiversity point of view
Small forest area for production
Small cutting incomes
Price premium for certified timber
Improvement in biodiversity and environment
Changes in consumers' preferences
Diminishing profitability
Diminishing cutting possibilities
Negative image if certification system is abandoned

Synthesis

Table 1: Priorities of the SWOT factors

SWOT group	Priority of the group	SWOT factors	Priority of the factor within the group	Overall priority of the factor
Strengths	**0.27**	Small 'eco costs' from certification	0.059	0.016
		Minor dependence on timber production	0.125	0.033
		Capacity to adapt and evolve certification system	0.408	0.109
		Synergy with agriculture and education units	0.408	0.109
Weakness	**0.15**	Monotonous forest from biodiversity point of view	0.094	0.015
		Small forest area for production	0.168	0.026
		Small cutting incomes	0.738	0.114
Opportunities	**0.50**	Price premium for certified timber	0.090	0.045
		Improvement in biodiversity and environment	0.143	0.071
		Changes in consumers' preferences	0.767	0.380
Threats	**0.08**	Diminishing profitability	0.122	0.010
		Diminishing cutting possibilities	0.230	0.019
		Negative image if certification system is abandoned	0.648	0.054

Information Systems Management

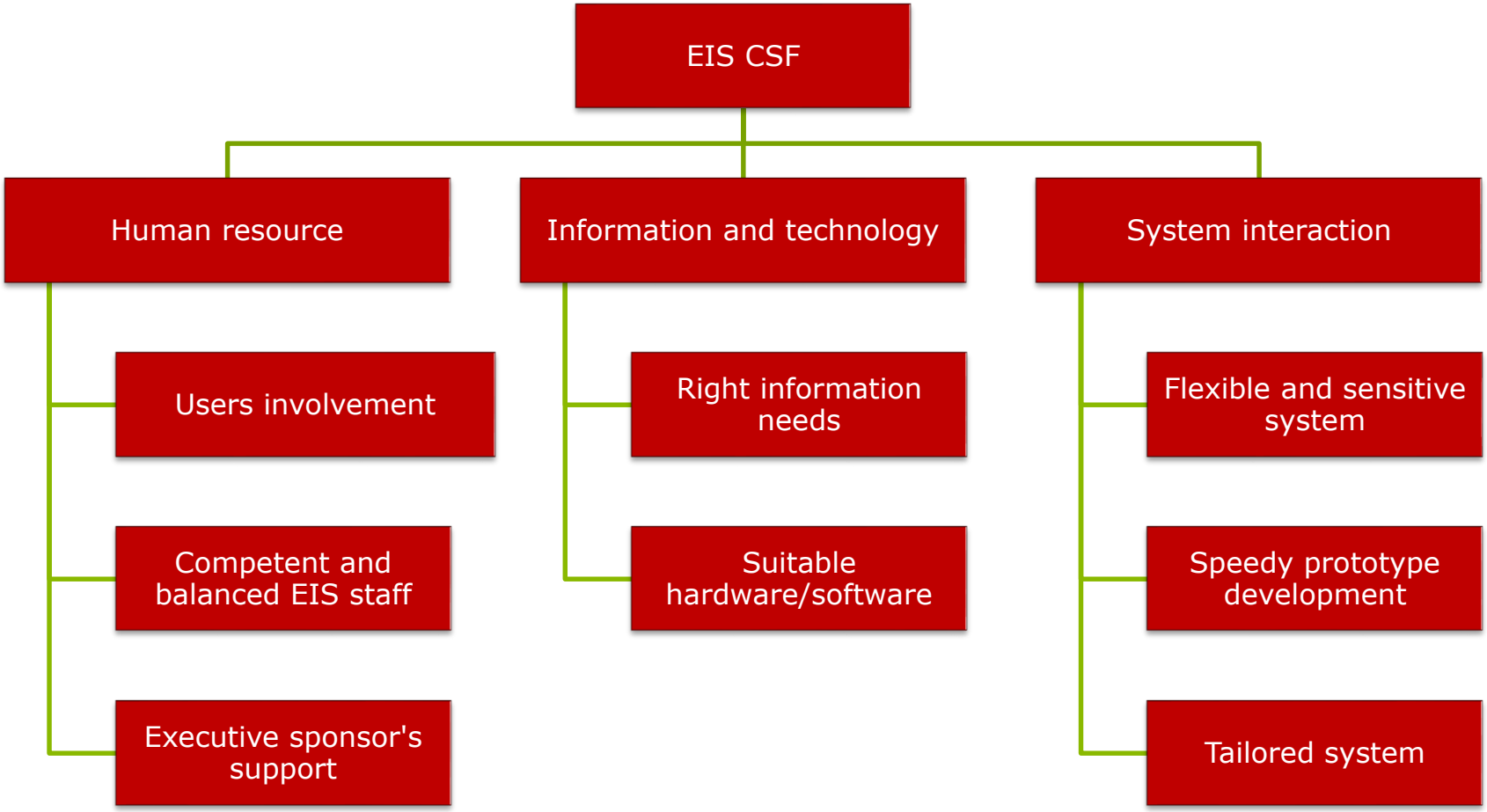
- Ranking Critical Success Factors for Executive Information Systems

Ranking Critical Success Factors for Executive Information Systems

- Rockert defined critical success factors or CSFs as "The limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization.

  They are the few key areas where things must go right for the business to flourish".
- The present work pertains to identifying and prioritizing CSFs to develop and implement executive information systems (EIS).
- EIS is a useful medium for communication across vertical as well as horizontal layers of an organization.
- Note that development of an EIS is a high risk project. Attention must be paid to certain important factors in course of development of an EIS.
- Since resources are limited, these should be disbursed to the factors according to their level of importance.

Hierarchy


EIS CSF
Human resource
Information and technology
System interaction
Users involvement
Competent and balanced EIS staff
Executive sponsor's support
Right information needs
Suitable hardware/software
Flexible and sensitive system
Speedy prototype development
Tailored system

Synthesis

Table 1: Summary of local weights

Categories	CSFs	Local weights	Global weights
Human resources (0.598)	Users' interest	0.540	0.153
	Competent and balanced EIS staff	0.163	0.046
	Executive sponsor's support	0.297	0.084
Info and tech resources (0.283)	Right info needs	0.889	0.532
	Suitable hardware/software	0.111	0.066
System interaction (0.119)	Flexible and sensitive system	0.320	0.038
	Speedy development of a prototype	0.122	0.014
	Tailored system	0.558	0.067

Table 2: CSF ranking with global weights

CSFs		Global weights	Category
1.	Right info needs	0.532	Info tech resources
2.	Users' interest	0.153	Human resources
3.	Executive sponsor's support	0.084	Human resources
4.	Tailored system	0.067	System interaction
5.	Suitable hard/soft	0.066	Info tech resources
6.	Competent and balanced EIS staff	0.046	Human resources
7.	Flexible and sensitive system	0.038	System interaction
8.	Speedy development of a prototype	0.014	System interaction

Financial Management

- Finding the Most Preferred Alliance Structure between Banks and Insurance Companies
- Determining the Right Merger Strategy for Taiwanese Banks

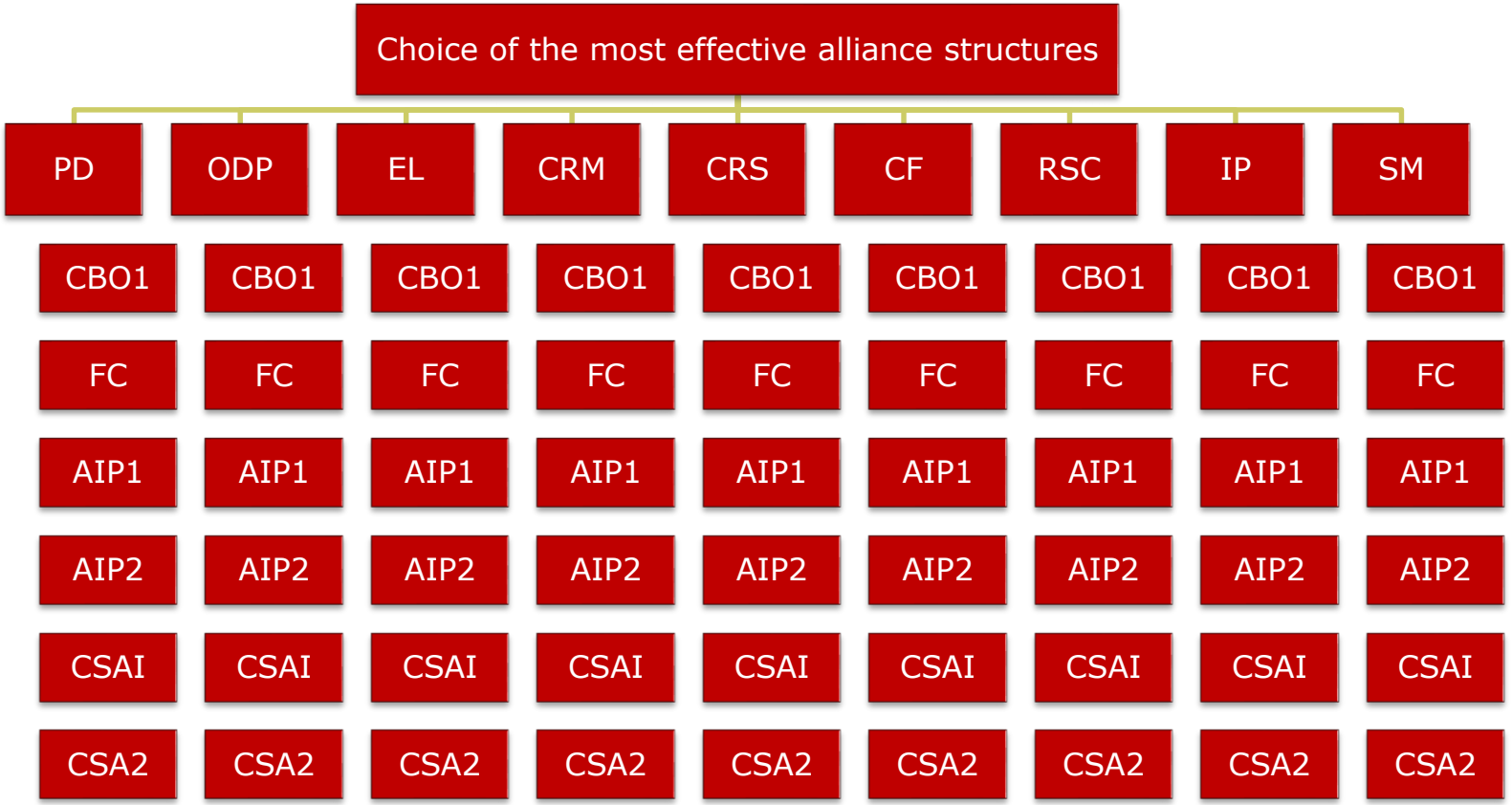
Finding the Most Preferred Alliance Structure between Banks and Insurance Companies

- Alliance formation is a common phenomenon in finance related industries. Usually, selection of the most desired alliance is governed by a multitude of criteria.
- In the present work, the authors have designed six alternative alliance structures and all these are evaluated on the basis of nine criteria.
- The priorities of the criteria and the alternative alliance structures are determined by interviewing a number of top managers and officers working in the Finish banks and insurance companies.
- The nine criteria used are: (1) Product development, (2) One-door principle, (3) Earnings logics, (4) Customer relationship management, (5) Cost and revenue synergies, (6) Chanel conflicts, (7) Required solvency capital, (8) Investor power, and (9) Sales management.

Alternatives

- Control by ownership when a bank owns an insurance company or vice versa (CBO1)
- Control by ownership (financial conglomerate): a holding company owns one or several banks and one or several insurance companies (FC)
- Alliance of independent partners with no overlapping service channels (AIP1)
- Alliance of independent partners with overlapping service channels (AIP2)
- Cross-selling agreement with no overlapping service channels (CSA1)
- Cross-selling agreement with overlapping service channels (CSA2)

Hierarchy


Choice of the most effective alliance structures
PD
ODP
EL
CRM
CRS
CF
RSC
IP
SM
CBO1
FC
AIP1
AIP2
CSAI
CSA2

PD:	**Product development (maximize efficiency)**
ODP:	One-door policy (implement as effectively as possible)
EL:	Earning logics (avoid conflicts)
CRM:	Customer relationship management (maximize efficiency)
CRS:	Cost and revenue synergies (maximize)
CF:	Channel conflicts (maximize)
RSC:	Required solvency capital (optimize the balance)
IP:	Investor power (maximize)
SM:	Sales management (maximize efficiency)

Synthesis

Table 1: The composite priority vector for the alliance structure models

	ODP	EL	CRM	CRS	CF	RSC	SM	Σ
	0.029	0.186	0.075	0.396	0.126	0.095	0.093	
CBO1	0.334	0.251	0.375	0.331	0.235	0.301	0.292	0.301
FC	**0.334**	**0.531**	**0.375**	**0.448**	**0.235**	**0.483**	**0.47**	**0.433**
AIP1	0.17	0.097	0.086	0.091	0.235	0.075	0.105	0.112
AIP2	0.047	0.036	0.086	0.059	0.036	0.075	0.038	0.053
CSA1	0.086	0.059	0.039	0.047	0.235	0.033	0.068	0.074
CSA2	0.03	0.026	0.039	0.026	0.024	0.033	0.028	0.028

Determining the Right Merger Strategy for Taiwanese Banks

- By the year 2005, Taiwan had 47 domestic banks and 31 credit operatives. For a small country like Taiwan, the number of banks was considered to be excessive. The Minister of Finance of Taiwan encouraged the banks to get merged and improve overall banking performance, as too many banks were competing with too many others.
- Due to the government directive, all the banks faced merger pressure. There were three merger options before the banks, namely (1) merging with financial organizations to become an existing bank, (2) merging with other financial organizations to become a merged bank, and (3) focusing on core business competition to become a specialized and stable bank.

Hierarchy


Merge Strategies
C1 Operation performance
C11 Operation efficiency
C111 business process reengineering
C112 establishing an enterprise integration system
C113 implementing the system of job responsibility
C114 fulfilling objective management
C12 Innovation process
C121 researching and developing various financial product
C122 enhancing the connection between operation and information technology
C123 creating a culture of enterprise vision
C2 Staff rights
C21 Human resource training
C211 enhancing pre-job training and on the job training
C212 cultivating international finance professionals
C213 Carrying out a system of specialization
C214 implementing a knowledge management system
C22 Huamn resource planning
C221 Human resource allocation
C222 Building a system of rewards and penalties
C223 Implementing a rotation of work system
C23 Staff satisfaction
C231 Creating a fair system of rewards and penalties
C232 Establishing a humanistic management system
C233 Considering both work and entertainment of employees
C3 Customer service
C31 Customer service
C311 Implementing a full teller mechanism
C312 Generating a business information center
C313 Creating a customer service center
C4 Financial composition
C41 Profitability efficiency
C411 Decreasig capital costs and expenses
C412 Increasing the market share of deposits and loan
C413 Increasing fee income
C414 Reducing the pressure from bad debt
C42 Capital manipulation
C421 Managing the capital utilization flow
C422 Keeping capital float
C423 Improving asset management
C424 Improving debt management
C5 Government policies
C51 Government finance policy
\C511 Improving domestic financial markets
C512 Promoting national international competitiveness
C6 Risk management
C61 Credit risk
C611 Strict internal controls
C612 Fulfilling the system of review credit
C613 Enhancing employee credit knowledge
C614 Providing base II guidance for credit risk
C62 Operation risk
C621 preventing computer crime
C622 Improving moral education
C623 Providing Base II guidance for operation risk
C63 Market risk
C631 Interest risk management
C632 Foreign exchange risk management
C633 Credit derivative risk management
C634 Providing BASE II guidance for market risk

Synthesis (1/2)

Table 1: The weights of the top 10 attributes according to the respondents groups

Rank	Superintendents G1	Economists G2	Executives G3	Shareholders G4	Staffs G5	Customers G6	Overall G7
1	C511 (0.0727)	C313 (0.0775)	C313 (0.0800)	C313 (0.0754)	C313 (0.0763)	C511 (0.0862)	C313 (0.0775)
2	C312 (0.0607)	C511 (0.0739)	C511 (0.0635)	C511 (0.0690)	C511 (0.0700)	C512 (0.0748)	C511 (0.0739)
3	C311 (0.0580)	C312 (0.0636)	C312 (0.0556)	C312 (0.0617)	C312 (0.0571)	C311 (0.0636)	C312 (0.0636)
4	C313 (0.0463)	C414 (0.0379)	C311 (0.0375)	C512 (0.0502)	C311 (0.0368)	C312 (0.0553)	C414 (0.0379)
5	C512 (0.0405)	C512 (0.0354)	C114 (0.0372)	C311 (0.0449)	C413 (0.0368)	C313 (0.0537)	C512 (0.0354)
6	C121 (0.0402)	C411 (0.0321)	C231 (0.0342)	C413 (0.0416)	C424 (0.0316)	C122 (0.0265)	C411 (0.0321)
7	C411 (0.0342)	C424 (0.0319)	C413 (0.0331)	C122 (0.0323)	C512 (0.0304)	C121 (0.0252)	C424 (0.0319)
8	C123 (0.0342)	C311 (0.0307)	C411 (0.0329)	C424 (0.0275)	C414 (0.0296)	C411 (0.0244)	C311 (0.0307)
9	C122 (0.0333)	C613 (0.0293)	C232 (0.0317)	C412 (0.0272)	C423(0.0270)	C113 (0.0239)	C613 (0.0293)
10	C414 (0.0319)	C123 (0.0283)	C111 (0.0285)	C411 (0.0272)	C421(0.0265)	C111 (0.0236)	C123 (0.0283)

Synthesis (2/2)

Table 2: Overall priorities of the 3 alternative merger options

Options	Superintendents G1	Economists G2	Executives G3	Shareholders G4	Staffs G5	Customers G6	Overall G7
A	**0.3532**	**0.3875**	**0.4313**	**0.3914**	**0.3687**	**0.3797**	**0.3837**
B	0.3178	0.2442	0.2083	0.2366	0.2549	0.2951	0.2645
C	0.3290	0.3683	0.3604	0.3720	0.3763	0.3252	0.3518

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Thank
You